CHALLENGES IN COMPOSITES FOR WIND POWER APPLICATIONS

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Wind turbines have grown in size over the years to a current situation where modern multi-megawatt turbines typically have blades in the order of 40 to 60m in length. These blades are constructed predominantly from composite materials, due to the possibility for favourable structural properties, weight and cost.

Due to the industry driver of continuing to bring down the cost of wind energy, rotor size continues to increase. This can be seen very clearly in the offshore market where there is a demand for increasingly large turbines. In response to this need, in 2011 Vestas announced the development of the V164, comprising of 80m long blades. The need for larger blades brings exciting challenges in both manufacturing and design. Advances in technology can enable the trend of increasing size to continue even further and can also be instrumental in helping to bring down the cost of wind energy in existing size machines.

There are particular areas of interest in wind turbine blade design with composites, in characterising performance and in development of improved material properties. Wind turbines are regularly exposed to highly variable wind conditions. This creates a complex fatigue loading on the blade materials which must be taken into consideration during design. Detailed understanding of the mechanisms of fatigue in both composite laminate and bonded structures is therefore of great value to the designer in creating optimised designs. Modelling of composite laminates and bonded structures is complex and challenging but further advances in this field could be of significant benefit to the industry.

At a fundamental materials level, improvements in strength to weight and cost (i.e. higher strength, lower weight or lower cost) of blade materials could further help to bring down the cost of energy. However, equally important is the need to be able to consistently apply the very large volume of materials in a cost effective manner during the manufacture process to ensure reliable operation of the finished blades.

Other material properties such as inherent material damping and ease of recycling at end of life are also major challenges within the wind turbine blade industry.

Advances in fundamental material properties, modelling capabilities and manufacturing techniques could all help composite materials to further bring down the cost of wind energy.